Biomedical Data Analysis

Beyond AI Prediction

Reveal the fundamental structure of your data
Connect findings to known biology and physiology

Biomedical Data Analysis · Explainable AI · Topological Data Analysis · Research Software

www.radscience.ai.kr

Challenges of AI-driven biomedical data analysis

01

Limited Generalization

Small cohorts increase the risk of overfitting, unstable performance, and uncertain results in unseen patients.

02

Hidden Data Structure

Conventional features and predefined labels may obscure trajectories, subgroups, connectivity, and other structures within the data.

03

Limited Scientific Interpretation

Prediction accuracy alone does not explain what the model learned, why a pattern matters, or whether it is coherent with biology.

Rad Science uses *xAI and *TDA to investigate model behavior and data structure.
Findings are then evaluated against established biomedical and physiological knowledge.

* xAI : Explainable AI * TDA : Topological Data Analysis

Data analysis designed for your dataset

01	02	03	04
Understand	**Build the representation**	**Investigate**	**Interpret and iterate**
Examine the research objective, study design, data-generating process, available labels, and technical limitations.	Transform the data into a representation matched to the question. This is where filtration, embedding and feature geometry are chosen, and where much of the analytical value is decided.	Establish statistical and machine-learning baselines, use xAI to examine model behavior, and apply TDA where structural patterns may add insight.	Review findings with domain experts, assess their consistency with established evidence and physiology, and use the results to guide the next analysis.

You and your data determine the analytical strategy – not the other way around.

What the collaboration produces

Data Analysis

- ✓ Interpretable evidence
  Model explanations, structural patterns, subgroup characteristics, and assessments of robustness and uncertainty.
- ✓ Domain-grounded findings
  Results interpreted with domain experts and evaluated in relation to established biomedical knowledge and physiology.
- ✓ Reproducible analytical assets
  Analysis-ready data, documented methods, reusable code, visualizations, and technical reporting.

Software Implementation

- ✓ Research applications
- ✓ Dashboards and visualization
- ✓ Data acquisition and processing
- ✓ Device-integrated prototypes

Once an analysis is validated, we can translate the workflow into a research tool

Multimodal biomedical data analysis

Data Modalities

01 **Univariate & Multivariate Time-Series**

02 **Biomedical Imaging**

03 **Omics Data**

04 **Structured Clinical & Experimental Data**

Multimodal Analytical Approach

Modality-Specific Representation

Preserve the essence of temporal, spatial, molecular, and clinical information before analysis.

Cross-Modal Intergration

Align patients, samples, events, and experimental conditions.

AI + xAI	feature contribution
Manifold Learning	geometric organization
TDA	persistent geometric structure

Domain-Grounded Interpretation

Study Design · Biomedical Knowledge · Physiology · Domain Expertise

Outcomes & Deliverables

- **Event & Anomaly Detection**
- **Signal & Image Segmentation**
- **Classfication & Stratification**
- **Cross-Modal Association & Network Analysis**

Delivered as:

Reproducible multimodal pipelines
Pilot research software tools

Three complementary views of biomedical data

01

AI + xAI

What can the model learn—and what drives its output?

Learns task-relevant patterns for detection, segmentation, classification, and prediction. xAI examines influential variables, regions, time points, and modalities.

REVEALS
Task performance · feature contribution · model behavior

02

Manifold learning

How are the observations geometrically organized?

Reveals lower-dimensional organization embedded within high-dimensional data while examining local neighborhoods and broader trajectories.

REVEALS
Neighborhoods · trajectories · gradients · transitions

03

Topological Data Analysis

Which structural features persist across scales?

Quantifies components, loops, cavities, and connectivity across a filtration, providing structural summaries that complement conventional features.

REVEALS
Persistent structure · subgroup differences · topological features

FOUNDATION ACROSS ALL THREE

Statistical validation + domain grounding

Effect Sizes · Uncertainty · Confounding · Robustness · Biomedical kKnowledge · Physiology

Where we have collaborated

Physiological Data Analysis

Multivariate and time-series analysis of complex physiological measurements, including 36-channel pharyngeal manometry.

Event detection · Structural features · Research visualizations

Small-Cohort Omics Analysis

Interpretable analysis of high-dimensional molecular and structured clinical variables, including treatment-response lipidomics.

Candidate features · Subgroup structure · Reproducible workflows

Biomedical Imaging

Segmentation and structural analysis of microscopy images, including separation of touching patient-derived organoids.

Segmentation pipelines · Morphological features · Quantified image measures

Research Software

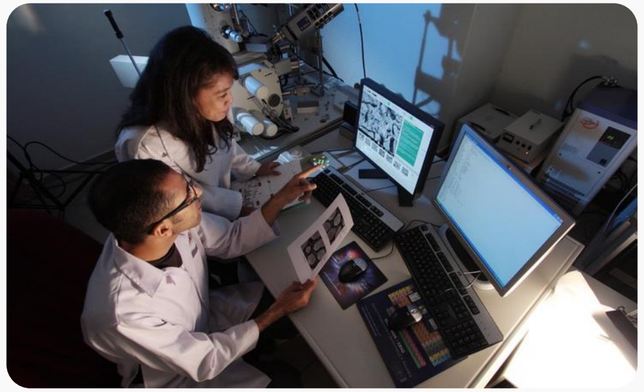
Optional extension: validated analyses translated into practical tools, including real-time pitch-tracking software.

Pilot software · Acquisition and feedback · Data logging and export

Start with a focused analytical pilot

Feasibility Pilot

One dataset, one research question, and one defined analytical objective.



Joint Research

Deeper analysis developed and interpreted together with domain experts.

Analysis to Software

A validated analytical workflow translated into an operational research tool.

Let's start with a 30-minute conversation.

Bring one dataset, one analytical bottleneck and one research decision — or simply the problem you have not been able to resolve. We will tell you whether deeper analysis, joint validation or software implementation is the right next step, including when the answer is no.

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